

USING OF LASER INDUCED BREAKDOWN SPECTROSCOPY TECHNIQUE FOR IN-SITU DUST DETECTION IN A NEXT-STEP TOKAMAK

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For the safe operation of future tokamaks, e.g., ITER, it will be very important to provide, from the very beginning of operation, reliable information on the amount of fine dust located on or transported to the surfaces of plasma facing components.

A technique based on laser-induced breakdown spectroscopy (LIBS) is proposed for in-situ dust detection on the plasma-exposed surfaces and in the grooves of plasma-facing components in the next-generation of fusion devices (e.g., ITER). It is based on laser-induced ablation of wall material and spectral analysis of the laser spark flash-light collected by imaging optics and transmitted to the detection system. This could give space- and time-resolved information on the presence of dust, or loosely bound films, their characteristic deposition patterns, elemental composition, and possibly their hydrogen content, without the necessity of breaking the machine vacuum.

We have performed some simple proof-of-principle experiments to demonstrate the suitability of this technique, which might provide an effective non-intrusive in-situ surface analysis method for surveying in-vessel dust accumulation in future fusion devices. In this paper we discuss the preliminary results, highlight some of the inherent advantages and difficulties and identify areas of further needed development.

Based on the preliminary results obtained, we are confident that this diagnostic method could be integrated in the present design of diagnostics installed in the ITER divertor. A conceptual design is outlined which could meet the space and the dust inspection requirements in the tokamak. The remaining area of R&D have been identified. They include work to establish the absolute sensitivity calibration, which permits to infer the amount of deposited material from the direct measurements of marker line intensities.